

REMARKS

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons which follow. After amending the claims as set forth above, claims 1-38 are now pending in this application. Support for new claims 33-38 may be found for example, in originally filed claims 1-3, 6 and 12. No new matter was added.

I. The § 112 Rejections Should Be Withdrawn

Claims 2-5, 15, 16, 29, 30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 2-5, 15, 16, 29, 30 have been amended to delete the limitation "the step of". Applicants submit that the amendment is sufficient to overcome the rejection.

II. The § 103(a) Rejections Over Mansfield Should Be Withdrawn

Claims 1-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over US PGPUB 2002/0094482 to Mansfield et al. ("Mansfield") in view of the non-patent publication of Helbert et al. (Handbook of VLSI Microlithography, ch. 2). Claims 23-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mansfield in view of US Patent No. 6,309,800 to Okamoto. These rejections are respectfully traversed.

A. Mansfield Is Antedated As Prior Art By The Declaration

Applicants submit herewith the Rule 131 Declaration of Leon Radomsky, one of the attorneys who prepared the present application. As discussed in the Declaration, the present inventors conceived the present invention prior to the January 18, 2001 filing date of Mansfield. Furthermore, Applicants' attorney and the inventors were diligent in preparing the present application from the date just prior to January 18, 2001 to the June 25, 2001 filing date of the present application.

As noted in MPEP § 2138.06 (last two sections), the diligence of an attorney preparing and filing the patent application inures to the benefit of the inventor. As

further noted in MPEP § 2138.06 (section titled "DILIGENCE REQUIRED IN PREPARING AND FILING PATENT APPLICATION"):

Reasonable diligence is established if attorney worked reasonably hard on the application during the continuous critical period. If the attorney had a reasonable backlog of unrelated cases which he takes up in chronological order and carries out expeditiously, that is sufficient.

In the present case, the attorney preparing the application had a reasonable backlog of unrelated cases which he took up in a priority order before preparing the present application. Thus, Applicants submit that the Rule 131 declaration is sufficient to remove Mansfield as prior art because the present inventors conceived the present invention prior to the filing date of Mansfield and the present inventors and their attorneys were diligent in constructively reducing the present application to practice from the Mansfield filing date to the filing date of the present application. Applicants respectfully request that all § 103(a) rejections based on Mansfield be withdrawn.

B. Mansfield Fails to Teach Or Suggest Claim Limitations

Even if the Rule 131 Declaration is not sufficient to overcome the §103(a) rejections over Mansfield in view of secondary references, independent claims 14, 23 and 33 contain limitations not taught or suggested in Mansfield or the secondary references.

For example, claims 14, 23 and 33 recite that the focus used to expose dense regions is different from the focus used to expose isolated regions. Mansfield teaches in paragraph [0035] that the partial coherence and numerical aperture of the two illumination conditions differ, but does not teach or suggest that that focus could be changed as well. In contrast, the present inventors realized that optimizing the focus for the dense and isolated pattern exposure reduces spherical aberration.

Claims 12 and 33 recite that values of exposure dose and defocus used to expose the dense regions or the at least one isolated region are located in a respective process window outside an overlap region between the respective process windows. Page 4, paragraph 1 of the Office Action states that Mansfield teaches that the masks are exposed according to the process windows for respective features on the masks

and refers to Figures 1 and 2 of Mansfield. However, while Figures 1 and 2 of Mansfield illustrates process windows, Mansfield does not teach or suggest that values of exposure dose and defocus used to expose the dense regions or the at least one isolated region are located in a respective process window outside an overlap region (105, 205) between the respective process windows, as shown in Figures 2A and 2B of the present application.

III. The § 103(a) Rejections Over Pierrat & Neisser Should Be Withdrawn

Claim 1 was rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 6,218,089 to Pierrat in view of US Patent No. 5,563,012 to Neisser. This rejection is respectfully traversed.

The Neisser patent is described in paragraph [0012] of the Mansfield published application (both the Neisser patent and the Mansfield application are assigned to IBM). Paragraph [0012] of Mansfield describes the Neisser patent as follows:

Another solution to the dilemma between sufficient process window and good imaging resolution was proposed in U.S. Pat. No. 5,563,012 to Neisser. Neisser describes methods of splitting a mask pattern having both isolated and tightly nested features into two or more modified or overlay masks. The mask features are divided among the two or more overlay masks such that each mask contains features having the same pitch. In a first embodiment, a mask pattern is split into two or more overlay masks, each having features which are relatively isolated, i.e., which have a relatively large pitch. The tightly nested features are divided into two or more overlay masks so that the resulting pitch of these features is approximately the same as the pitch of the isolated features. The isolated features are then added to any one of the overlay masks. Each overlay mask pattern is then lithographically printed onto a substrate using the same exposure conditions for each mask.

In a second embodiment, a mask pattern is split into two or more overlay masks, each having features which are tightly nested. The isolated features of the mask pattern are added to one or more of the overlay masks, along with "dummy" features, so that the resulting pitch of these features is approximately the same as the tightly nested features. The tightly nested features are then added to any

one of the overlay masks. Each overlay mask pattern is then printed onto a substrate, again using the same exposure conditions for each mask.

Thus, Neisser teaches to form either dense or isolated features on both masks. In the first embodiment, Neisser teaches that one dense pattern is converted into two isolated patterns on two masks. Thus, in the first embodiment, both masks have isolated patterns, rather than an isolated pattern on one mask and a dense pattern on another mask, as recited in claim 1.

In the second embodiment, Neisser teaches that one isolated pattern is converted into two dense patterns with dummy features. Thus, in the second embodiment, both masks have dense patterns, rather than an isolated pattern on one mask and a dense pattern on another mask, as recited in claim 1. Therefore, Neisser fails to teach or suggest exposing dense and isolated regions on the same photoresist layer using separate masks as recited in claim 1.

The other reference used in the §103(a), Pierrat, does not teach grouping dense and isolated features on the different masks, as admitted in the Office Action. Thus, Pierrat does not remedy the deficiency of Neisser. Applicants respectfully request a withdrawal of the § 103(a) rejection.

IV. Conclusion

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date 3/18/03

By Leon Radomsky

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**MARKED UP VERSION SHOWING CHANGES MADE**

Below are the marked up amended claim(s):

2. (Amended) The method of claim 1, wherein [the step of] patterning the photoresist layer comprises removing the exposed dense and isolated regions in the photoresist layer.

3. (Amended) The method of claim 1, wherein [the step of] patterning the photoresist layer comprises removing the unexposed regions in the photoresist layer without removing the exposed dense and isolated regions in the photoresist layer.

4. (Amended) The method of claim 1, wherein:
the first layer comprises an insulating layer; and
[the step of] patterning the first layer comprises providing an etching gas or an etching liquid to the first layer through openings in the patterned photoresist layer to form a plurality of dense and isolated openings in the first layer.

5. (Amended) The method of claim 1, wherein:
the first layer comprises a semiconductor or a conductive layer; and
[the step of] patterning the first layer comprises providing an etching gas or an etching liquid to the first layer through openings in the patterned photoresist layer to form a plurality of features in the first layer.

15. (Amended) The method of claim 14, wherein:
the first layer comprises an insulating layer; and
~~[the step of] etching the first layer comprises providing an etching gas or an etching liquid to the first layer through openings in the patterned photoresist layer to form a plurality of dense and isolated openings in the first layer.~~

16. (Amended) The method of claim 14, wherein:
~~The first layer comprises a semiconductor or a conductive layer; and~~

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[the step of] etching the first layer comprises providing an etching gas or an etching liquid to the first layer through openings in the patterned photoresist layer to form a plurality of features in the first layer.

29. (Amended) The method of claim 23, wherein [the step of] exposing the dense regions occurs before [the step of] exposing the isolated regions.

30. (Amended) The method of claim 23, wherein [the step of] exposing the dense regions occurs after [the step of] exposing the isolated regions